# Comparisons of Satellite-Deduced Overlapping Cloud Properties and CALIPSO/CloudSat Data

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# Outline

- Introduction to the overlapped cloud properties derived from polar-orbiting (MODIS) and geostationary (GOES-12, -13, Meteosat-8, -9, etc.) meteorological satellites, which are produced at the NASA Langley Research Center (LaRC) cloud research & development team (NASA lead scientist: Dr. Patrick Minnis).

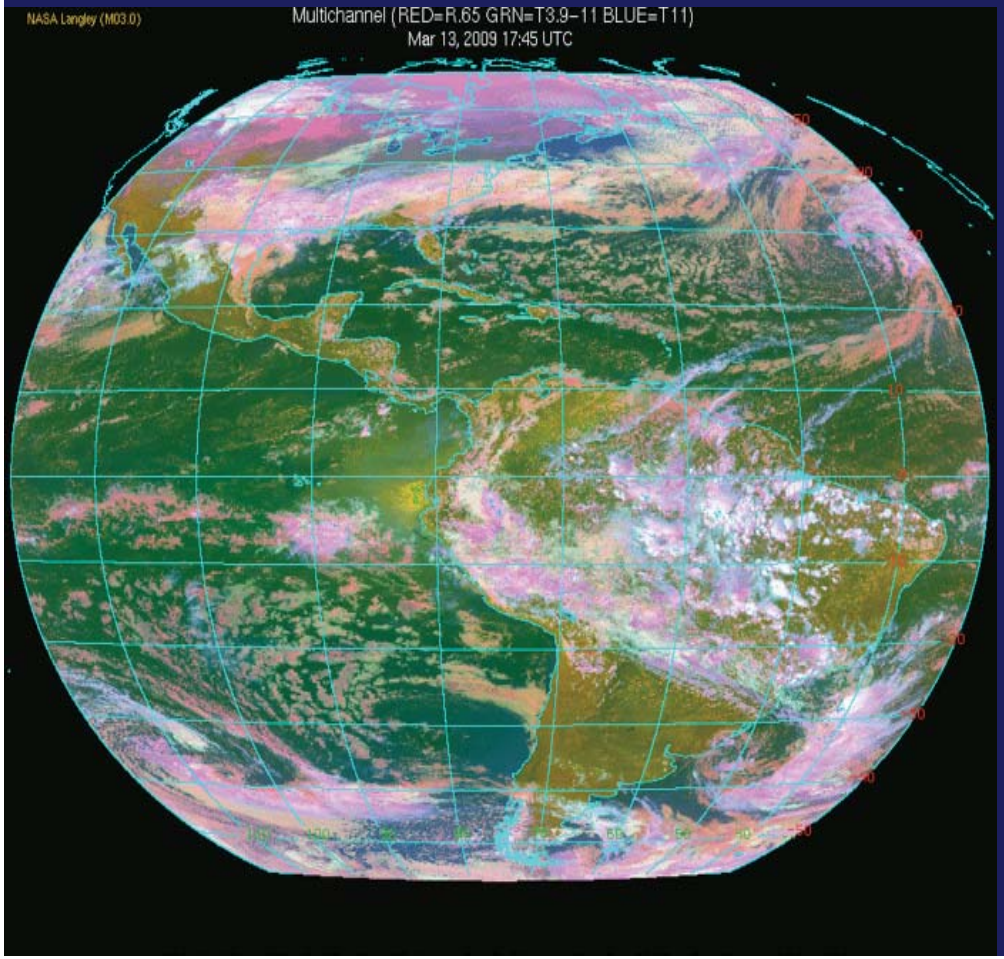
- Comparison of the LaRC CERES MODIS Edition-3 overlapped cloud properties to the CALIPSO and the CloudSat active sensing data.

**CERES – Cloud and Earth's Radiant Energy System*
**CALIPSO – Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation*
**CloudSat – A cloud radar satellite instrument*

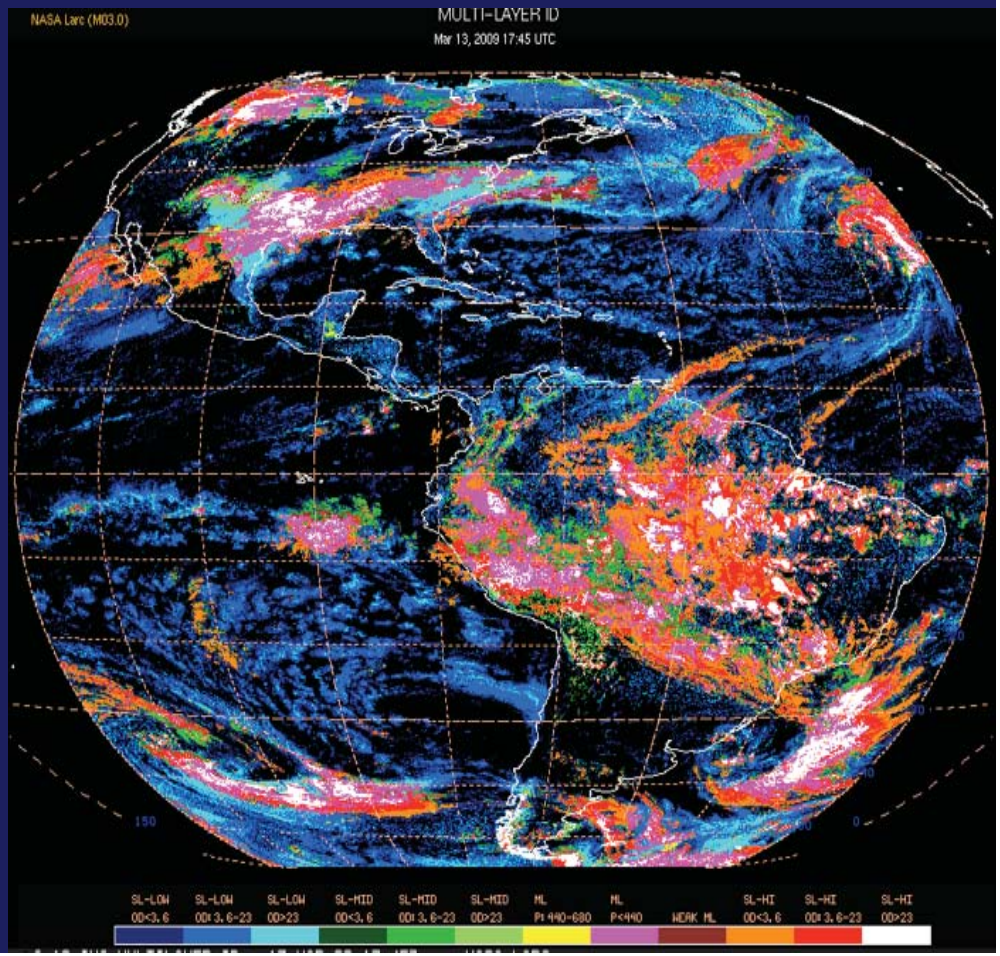
# Objective and Illustration

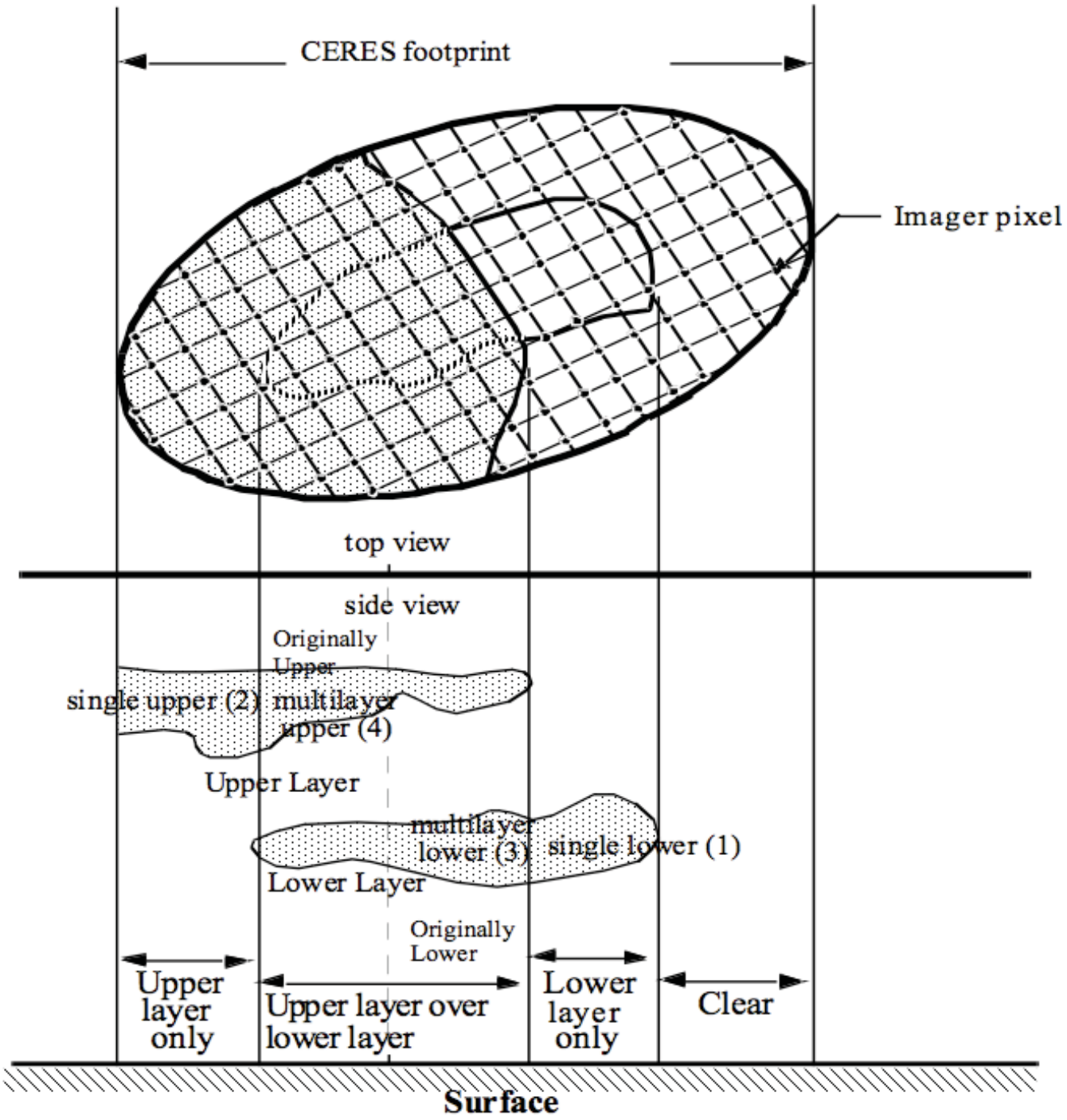
- Retrieve high cirrus cloud and cirrus-overlapped low cloud properties

GOES-12 satellite RGB image

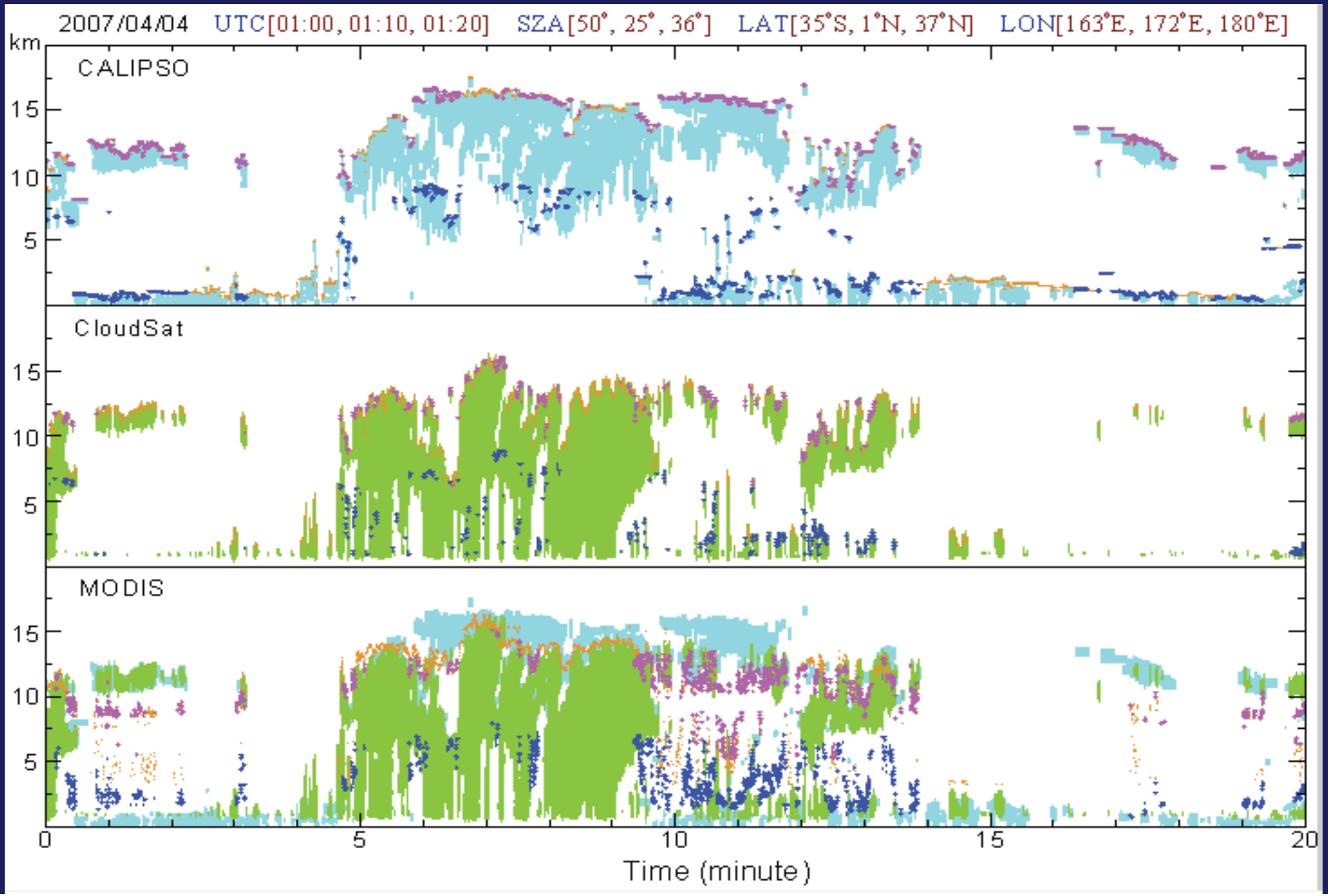



Retrieved overlapped cloud mask




CERES footprint
Imager pixel
top view
side view
Originally
Upper
single upper (2)
multilayer
upper (4)
Upper Layer
multilayer
lower (3)
single lower (1)
Lower Layer
Originally
Lower
Upper
layer
only
Upper layer over
lower layer
Lower
layer
only
Clear
Surface

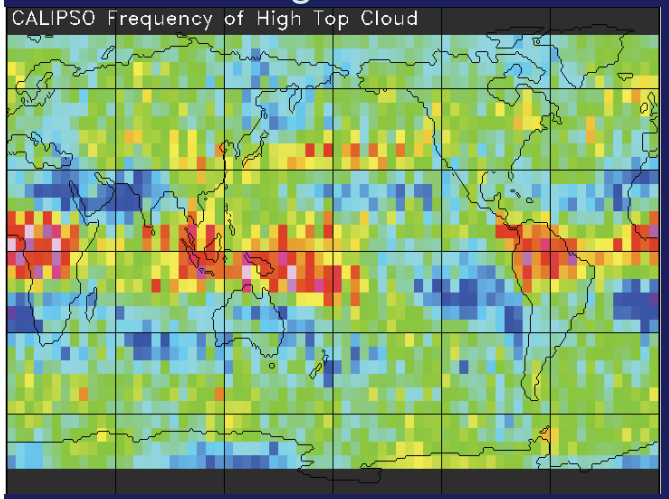
# Cloud Overlaps from CALIPSO, CloudSat and MODIS



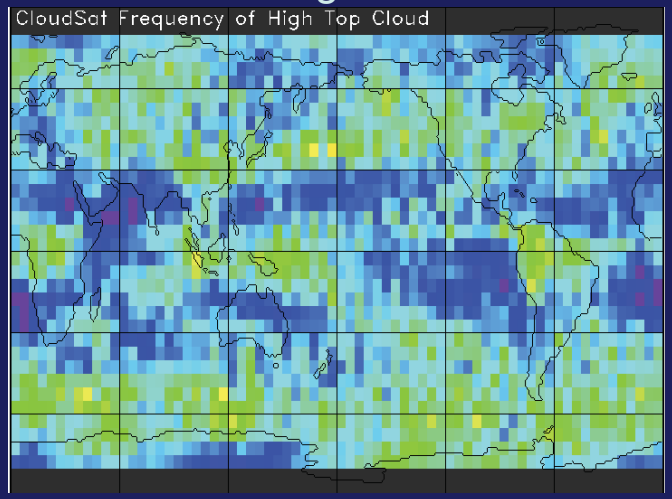
# Frequency of High Top Clouds and Overlapped Clouds

(April 2007)

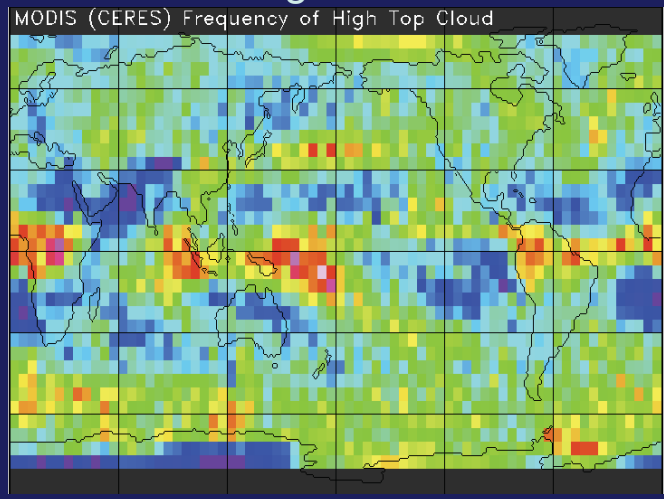
CALIPSO high cloud ~ 44%



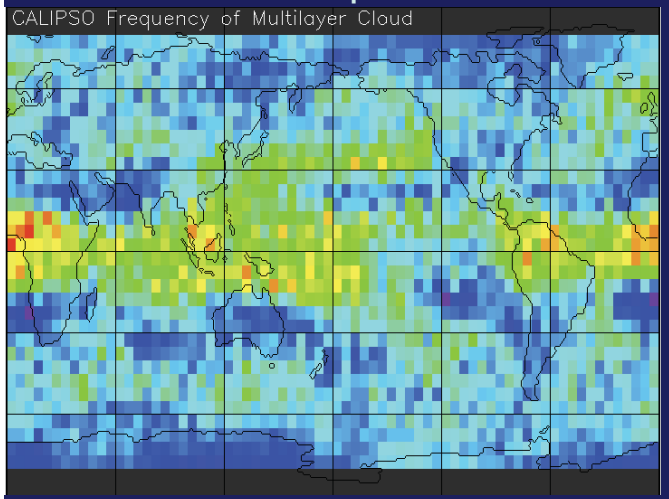

CloudSat high cloud ~ 25%



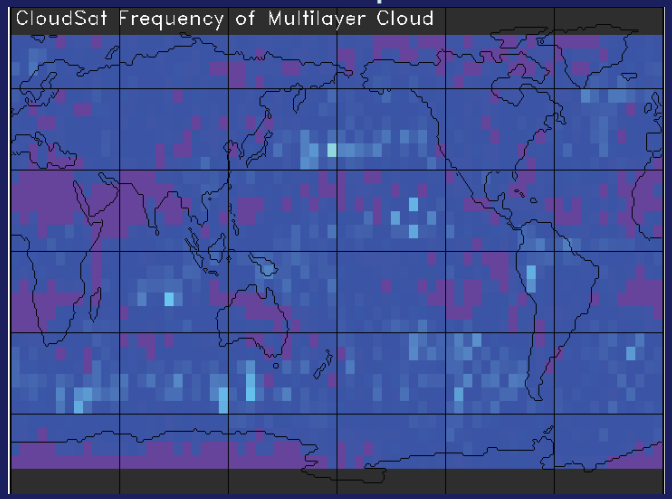

MODIS high cloud ~ 37%



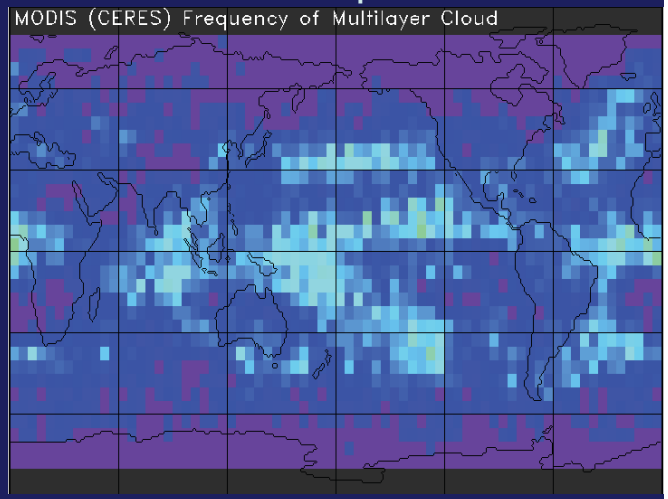

CALIPSO overlap cloud ~ 25%




CloudSat overlap cloud ~ 4%



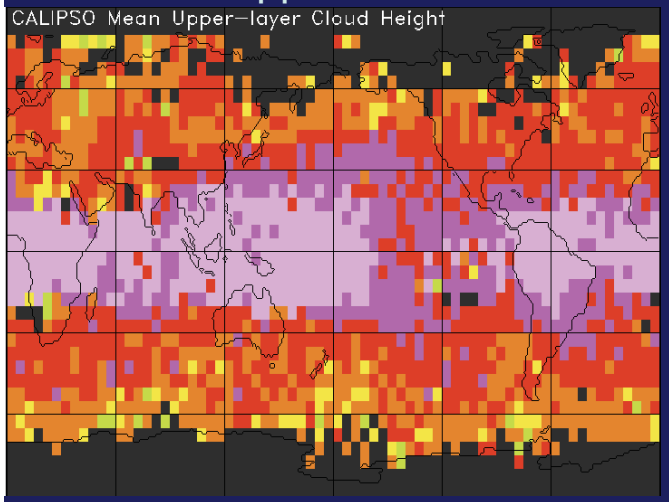

MODIS overlap cloud ~ 6%



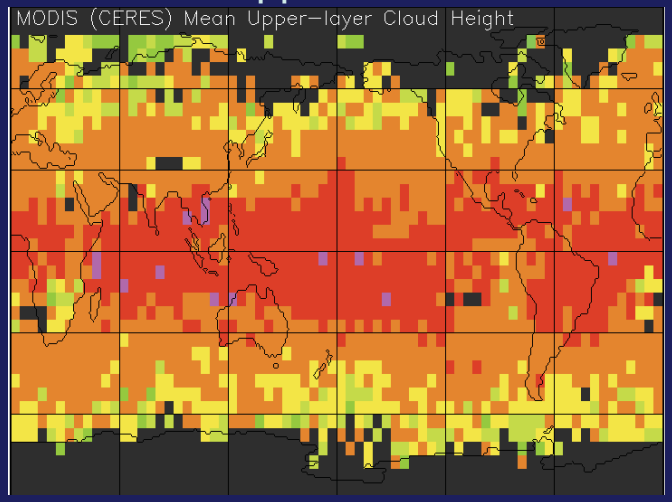
# Comparisons of Upper and Lower-layer Cloud Top Heights

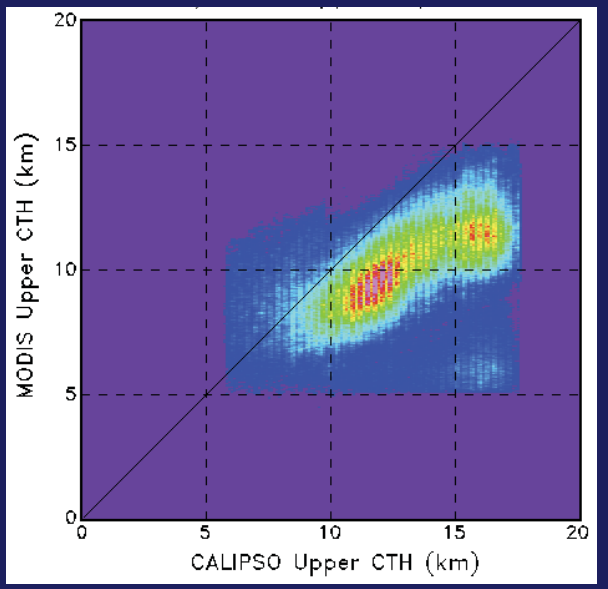
## CALIPSO and MODIS matched overlap clouds (April 2007)

CALIPSO upper CTH ~ 12.8 km

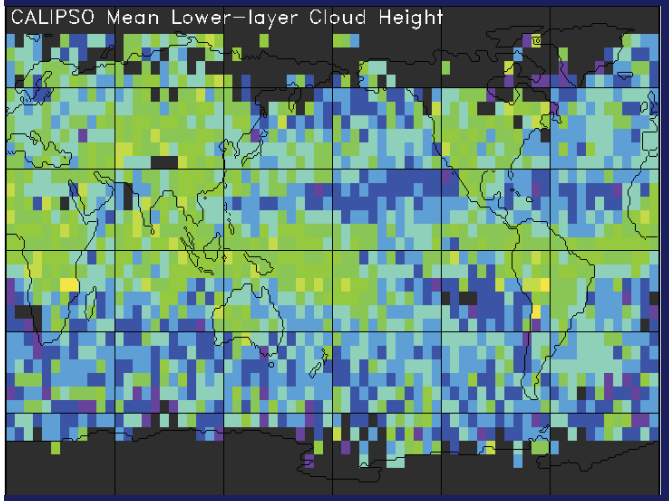



MODIS upper CTH ~ 10 km

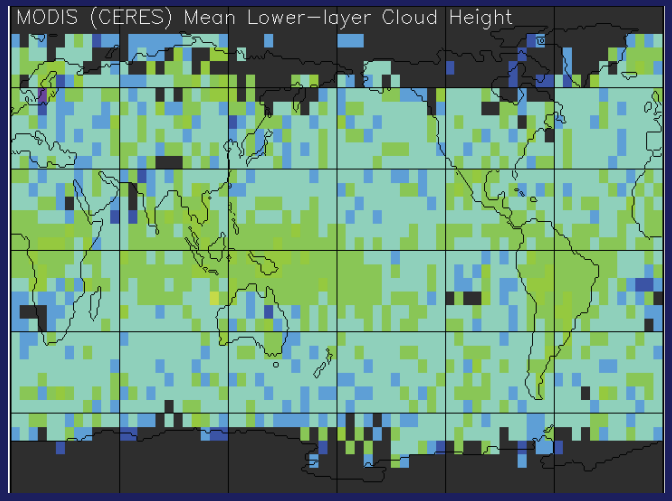


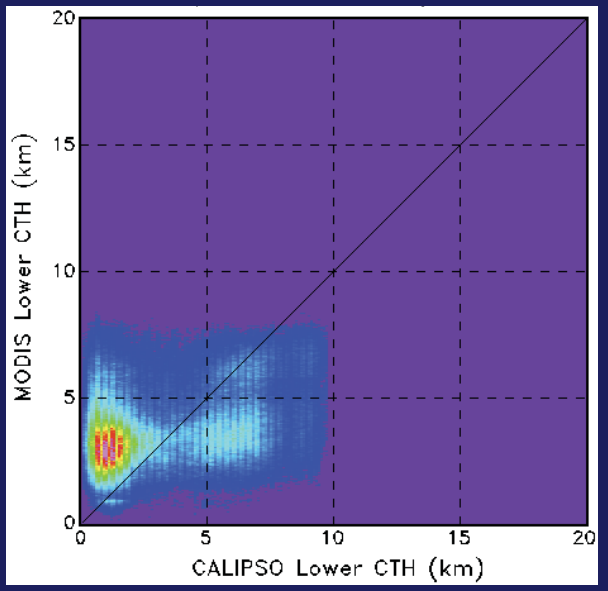



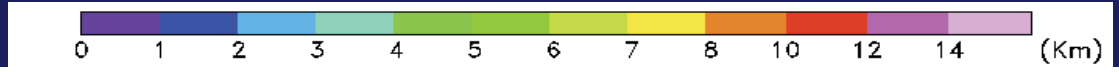

CALIPSO lower CTH ~ 3.6 km




MODIS lower CTH ~ 3.8 km



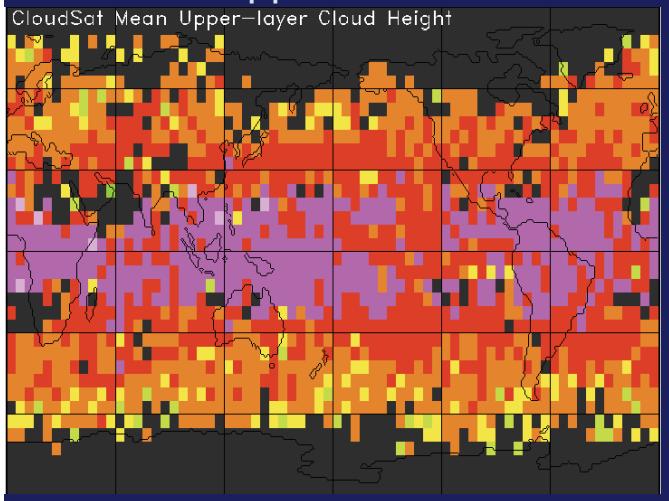



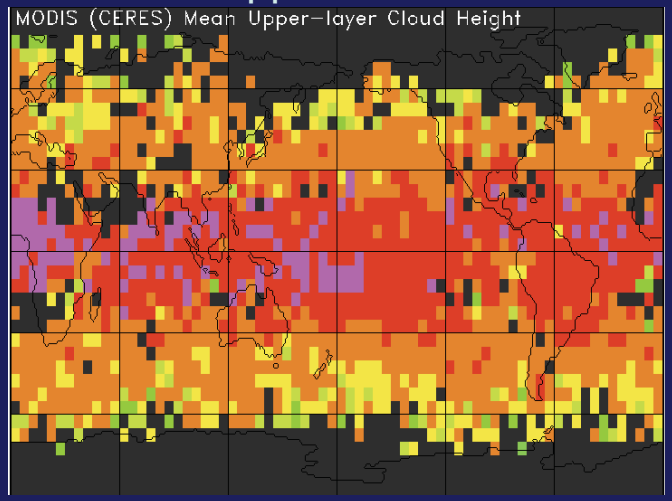
# Comparisons of Upper and Lower-layer Cloud Top Heights

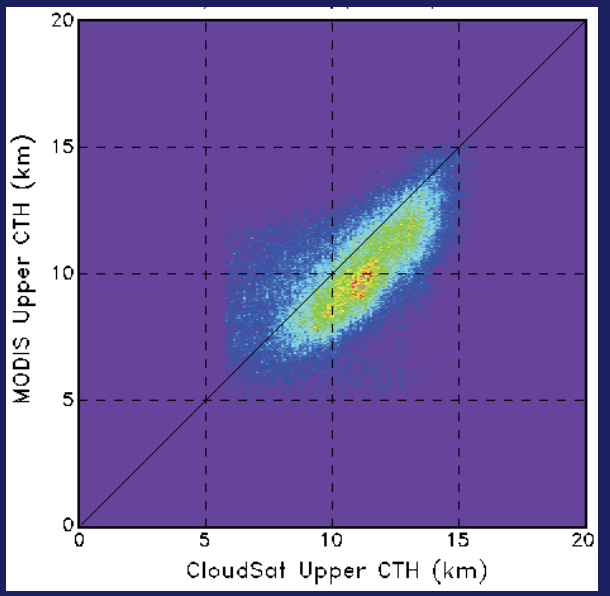
## CloudSat and MODIS matched overlap clouds (April 2007)

CloudSat upper CTH ~ 10.9 km

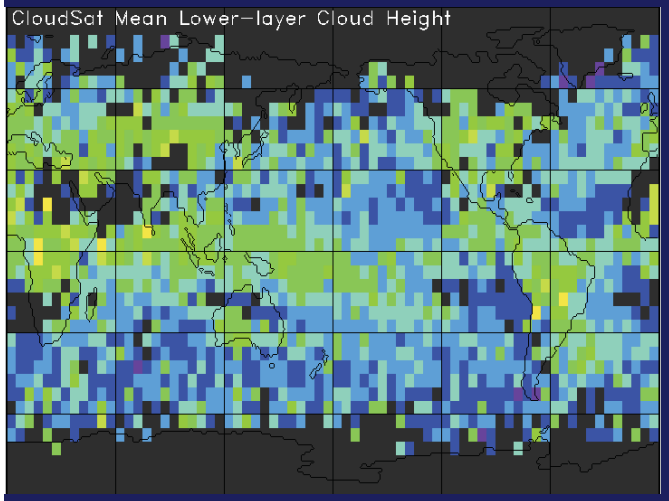



MODIS upper CTH ~ 10 km

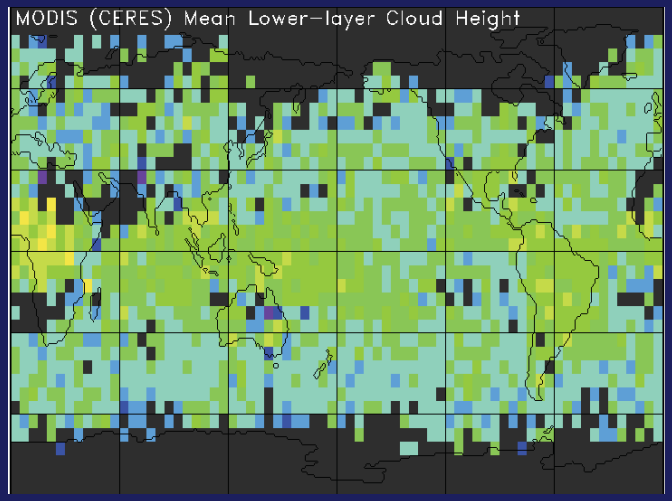


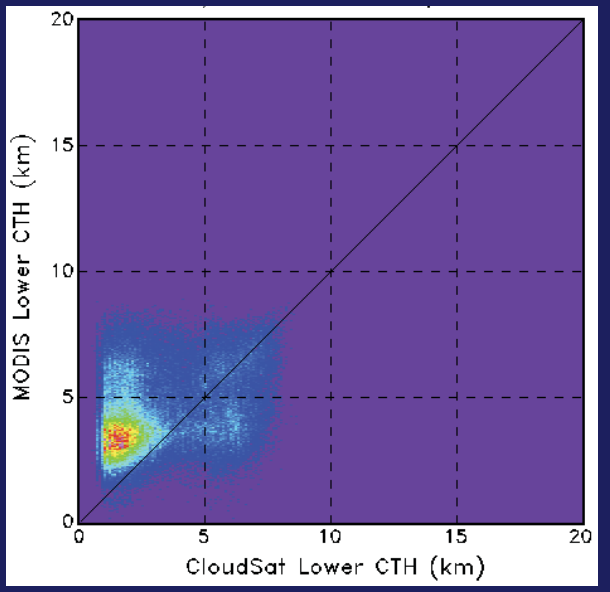



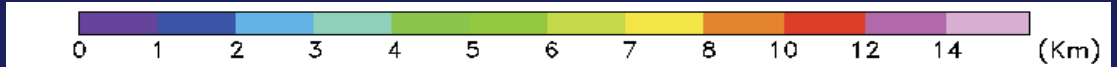

CloudSat lower CTH ~ 3.2 km




MODIS lower CTH ~ 4 km



## Summary and Conclusions

- High clouds and overlapped clouds occur frequently as deduced by CALIPSO (44 & 25%), CloudSat (25 & 4%), and MODIS (37 & 6%).
- Large fractions of optically-thin cirrus and overlapped clouds are deduced from CALIPSO, but much smaller fractions are from CloudSat and MODIS.
- For overlapped clouds, the averaged upper-layer CTHs are about 12.8 (CALIPSO), 10.9 (CloudSat) and 10 km (MODIS), and the averaged lower-layer CTHs are about 3.6 (CALIPSO), 3.2 (CloudSat) and 3.9 km (MODIS).
- Based on comparisons of upper and lower-layer cloud properties as deduced from the MODIS, CALIPSO and CloudSat data, more enhanced passive satellite methods for retrieving thin cirrus and overlapped cloud properties are needed and are under development.